Designers Plan Drones To Probe Atmosphere

Craft would work where planes and satellites can't.

By WARREN E. LEARY

WASHINGTON

Between the sky above and the earth below lies a place that scientists study only with great difficulty: the critical region of the atmosphere where the highest clouds form and gases interact with radiation from space. This zone, too high for most aircraft to reach and too low for thorough satellite observations from space, is prompting the development of a new class of robot airplanes to monitor ozone depletion and global warming.

Atmospheric scientists conclude that they must explore this rarefied region, lying from 10 to 20 miles above the earth, if they are to understand basic mechanisms of global climatic change. And the best way to get instruments up to this region and keep them there long enough for meaningful observations, they say, is with remotely piloted aircraft.

A half-dozen companies are proposing drones designed to work at these altitudes, travel thousands of miles without refueling or stay high in the sky for days, if not weeks, at a time. All the designs resemble futuristic gliders — with pencil-slim bodies and long tapered wings — that are pushed through the scant upper air by giant propellers.

Some of the proposals are modifications of military models, while others harness unusual engines, airframes and materials to the task of operating routinely in the harsh environment of the upper atmosphere. One company is developing a gasoline engine that recycles its exhaust and mixes it with oxygen carried aboard the plane to maintain the pressure and power needed to turn a large propeller and operate at extreme altitude. Another proposes fueling its plane with microwave energy fired from the ground.

"No question about it, there is a revolution going on in how people are thinking about using remotely piloted aircraft in atmospheric research," said Dr. James G. Anderson, a professor of chemistry at Harvard University. "I can't imagine this field in the future without unmanned aircraft. The time is ripe."

Dr. Anderson, a mission scientist for the National Aeronautics and Space Administration's Airborne Arctic Stratospheric Experiment-2, an aerial assault on the ozone problem based in Bangor, Me., said the single greatest restraint on science in studying ozone loss "is the inability to get deep into the higher altitudes of the atmosphere where the chemistry is happening, particularly over polar regions."

Dr. Ari Patrinos, director of the Energy Department's environmental sciences division, also sees pilotless aircraft as a unique solution for gathering data on climate change. "Their time has come, and I'm quite optimistic the ones we need can be developed," he said.

As part of its Atmospheric Radiation Measurement Program, the Energy Department has requested $10 million in the fiscal year 1993 to begin developing drones that can probe the tropopause, the special boundary region between the troposphere and the stratosphere.

Aircraft, balloons, small rockets and satellites are used to study the tropopause, but each has serious shortcomings.

Satellites are fine for giving an overall picture of the atmosphere but

Continued on Page B8

Designers Plan Drones to Probe Atmospheric Clues to Climate

Continued From Page B5

because they measure chemical interaction indirectly, they cannot provide the precise information scientists need. Satellite users often do not know what they have seen or if their readings are true unless the measurements are compared with data gathered directly in the atmosphere, researchers say.

Balloons cannot be maneuvered to areas of interest, since they are at the mercy of the winds, and are often lost along with an expensive instrument package. The ER-2, a modified version of the famed U-2 spy plane, has done invaluable work, including confirming the existence of the Antarctic ozone hole. But the single-engined jet is limited to 70,000 feet, about 13 miles, and its maximum airborne time is eight hours.

Dangers and Difficulties

"The ER-2 has a very, very good record and its pilots have done a magnificent job, but it's difficult and dangerous to use manned aircraft for this kind of work, particularly in remote areas," said Dr. Adrian F. Tuck of the National Oceanic and Atmospheric Administration.

The only other conventional plane that can go higher, reportedly exceeding 80,000 feet, is the SR-71 Blackbird jet. Unfortunately, Dr. Tuck said, the recently retired spy plane flies at three times the speed of sound, producing heat and shock waves at 2,000 miles per hour that destroy or scatter the very molecules it would be sent to study.

Atmospheric physicists have come to realize that pilotless vehicles would be the solution to all their problems. "We're really going to need unmanned aircraft to give us the answers we need without putting men at risk," said Dr. Tuck, chief of meteorological chemistry at the atmospheric agency's Aeronomy Laboratory in Boulder, Colo. Remotely piloted aircraft could provide crucial information on global change for policy makers long before it is available elsewhere, he said, such as through NASA's proposed Earth Observing System, a network of advanced space satellites that will not be operational for a decade.

Last July in San Diego, at a workshop held by the space agency and the University of California, atmospheric scientists met with aircraft makers and concluded that there was a need for a variety of pilotless planes with a mix of payloads, ranges and flight endurance times.

Strangely enough, an aircraft that fulfills many of the specified needs has already been produced but lies unused in a storage hangar. Called the Condor, it was developed by Boeing as a secret Defense Department project and completed eight

> 'We're really going to need unmanned aircraft to give us the answers we need.'

successful test flights in 1989 but was mothballed because the military could not find a mission for it.

The Condor, enormous by the standards of pilotless vehicles, has a wing span of 200 feet and is driven by a pair of three-blade propellers that measure 16 feet in diameter. The plane holds the altitude record for piston-powered aircraft of 67,028 feet. During one of its flights, it stayed aloft two and a half days, and it has an estimated range of more than 20,000 miles without being refueled.

John Dale, head of Condor flight operations for Boeing's Defense and Space Group, said the company was waiting for various Federal agencies to decide what to do with the plane. Engineers have come up with suggested improvements to its engines and propellers that they feel give Condor the potential of operating at 85,000 feet or better, he said.

High Price of Plane

Atmospheric scientists want the Condor badly, but no one can find money in meager research budgets to buy it, at a reported $20 million to $25 million a plane, let alone to operate it.

"The Condor has the payload and the range to do so many things, and it already exists," said Dr. Tuck of the atmospheric agency. "It seems irrational not to take something that was built for the military and literally beat this sword into a plowshare for atmospheric research."

The first unmanned aircraft to see regular duty as a high-altitude scientific drone will probably be the Perseus-A, a 1,300-pound powered sailplane being developed by Aurora Flight Sciences of Manassas, Va. Under a new Small High Altitude Science Aircraft program, NASA is investing $2.75 million in hopes of getting two of the aircraft with option on a third. Perseus-A is designed to fly four-to-six-hour missions to 82,000 feet, more than 15 miles up, with a 110-pound payload.

John S. Langford, president of Aurora, said the technology of Perseus was quite basic. To hold down weight, the craft is made largely of Kevlar and graphite composite fiber. It has a 65-horsepower gasoline engine that turns a two-blade, 15-foot-diameter propeller at the rear of the aircraft. Instead of using a turbocharger to compress outside air to maintain power, engineers designed Perseus to recycle its exhaust in a closed-loop system into which fuel and liquid oxygen are injected.

A small-scale prototype, powered by a conventional ultralight aircraft engine, made several successful test flights in November at Edwards Air Force Base in California.

Jennifer Baer-Riedhart, project manager of the program at NASA's Ames-Dryden Flight Research Center, said the agency, which hopes to take delivery of the drones early next year, is keeping program costs low by taking a chance on the private company's Perseus concept. "We're not sure it will work, but we are taking a risk on the aerodynamics, propulsion system and other things," she said. "In the past, if you were developing this kind of aircraft from scratch, you'd be looking at a $40 million to $50 million program."

Drones like Perseus offer a way for developing countries and research groups with little money to study the effects of global change and have a say in writing environmental regulations based upon their own information, Mr. Langford said.

Microwave-Powered Plane

One of the most unusual proposals for a long-duration pilotless aircraft comes from Endosat Inc., a company in Rockville, Md., that has resurrected the idea of powering a plane with microwave energy beamed up from the ground. In theory, such a vehicle could stay aloft for weeks or months.